Space Weather Technical Forecast

Issued on Wednesday, 23 February 2022 at 00:32 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance throughout of M-class flares. Increasing Chance of Active fluence levels, mainly from day 2 (24 Feb) onward.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant flares. There are currently three sunspot regions on the Earth-facing disc. AR2953 has shown some growth in its intermediate spots, length and areal extent with a rudimentary penumbra in its leading spot. AR2954 in the NE appears to be a mature but stable Hsx/Alpha region. To the SE of this region AR2955 has emerged, which is also classified as an Hsx/Alpha. This region may be showing signs of increased complexity as it rotates onto the disk with some spots in its trailing region beginning to emerge. It is thought that this is the returning EX2938, which was the likely source of a notable far-sided flare and CME on the 15th Feb.

No Earth-directed CMEs were observed in the available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, has indicated that Earth has been connected to the High Speed Stream (HSS) from a positive coronal hole, CH56/+. The wind speed has been mostly elevated, between 500 and 590 km/s. The density has been mostly average. The total magnetic field strength (IMF) Bt, has been weak (<8 nT), with the Bz fluctuating between -6nT and +5nT. The phi angle has been mostly positive (away from the Sun) throughout. Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3) with Active (Kp 4) intervals between 22/0300-0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES 16 has returned to background levels. The high energy electron flux (greater than 2MeV) has been at background levels but increased to moderate levels from 22/1000 UTC reaching a peak of 530 pfu at 22/1730 UTC. The corresponding 24-hour integrated electron fluence is well below the Active (1e8 integrated pfu) threshold, but increasing slowly. The 23/0001 UTC observation was 1.28e7 pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Very Low or Low, but there is a slight chance of rising to Moderate levels through the 4 days due to the potential for flaring from the two regions in the northeast. The other sunspot region on the Earth-facing disc is currently unlikely to produce significant flares, though this region has recently shown signs of growth.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the forecast. Earth is experiencing a high speed stream from CH56/+, with this expected to persist during day 1 (23 Feb), before gradually easing. Geomagnetic activity is expected to start Quiet to Unsettled, with a chance of Active intervals and slight chance of a G1/Minor Storm days 1 (23 Feb). However, this risk will reduce through the forecast period and activity is expected to become predominantly Quiet for days 2 to 4 (24 to 26 Feb).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy (greater than 2 MeV) electron flux is currently Moderate, but may continue to trend upwards with a chance of peaking at High (greater than 1000 pfu) levels around the diurnal maximum. The associated fluence is also likely to rise, with a chance of exceeding the Active threshold (1e8 integrated pfu), most likely on day 3 or 4 (25-26 Feb).

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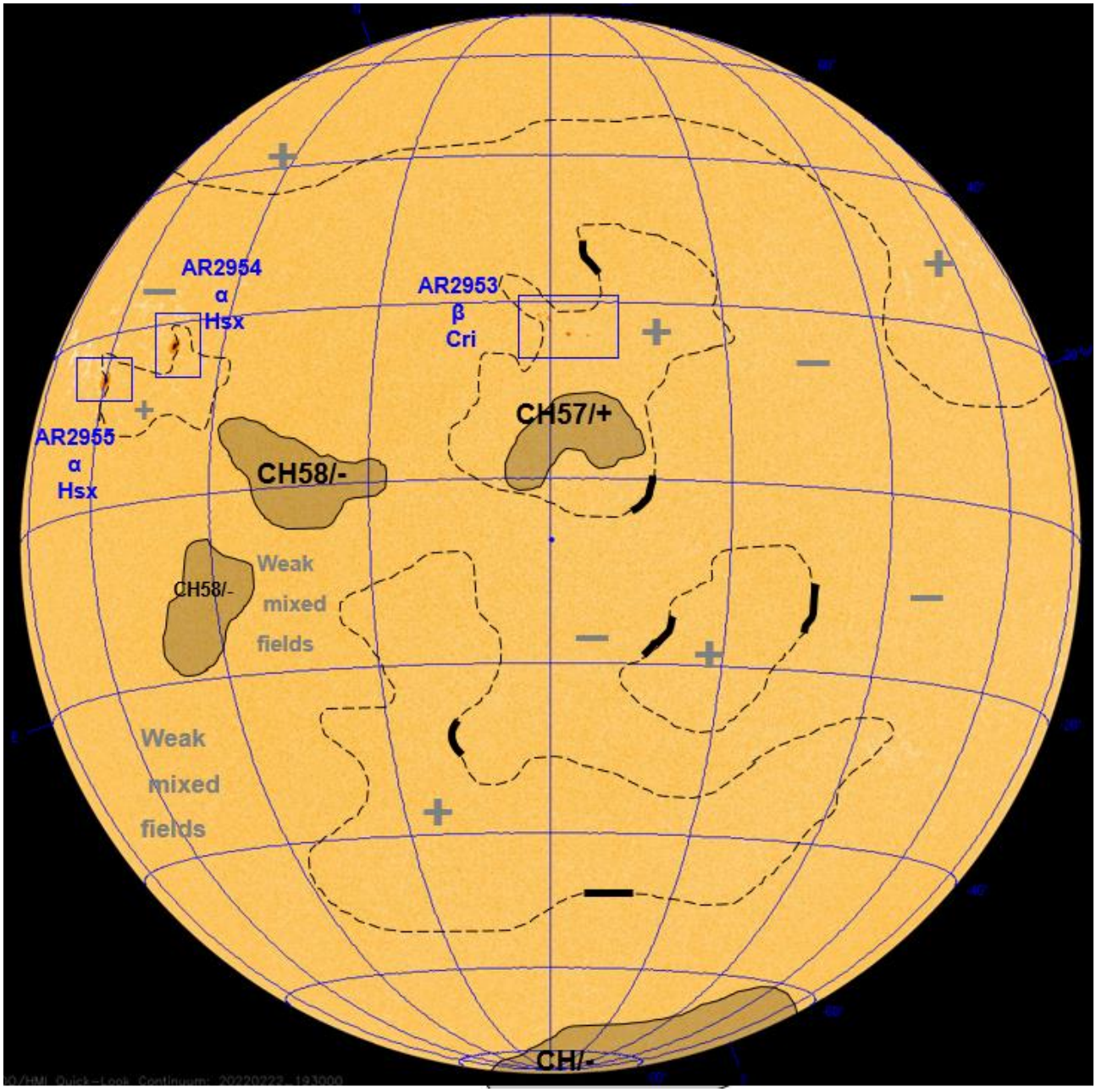
Figure 1. Solar Analysis Valid 22/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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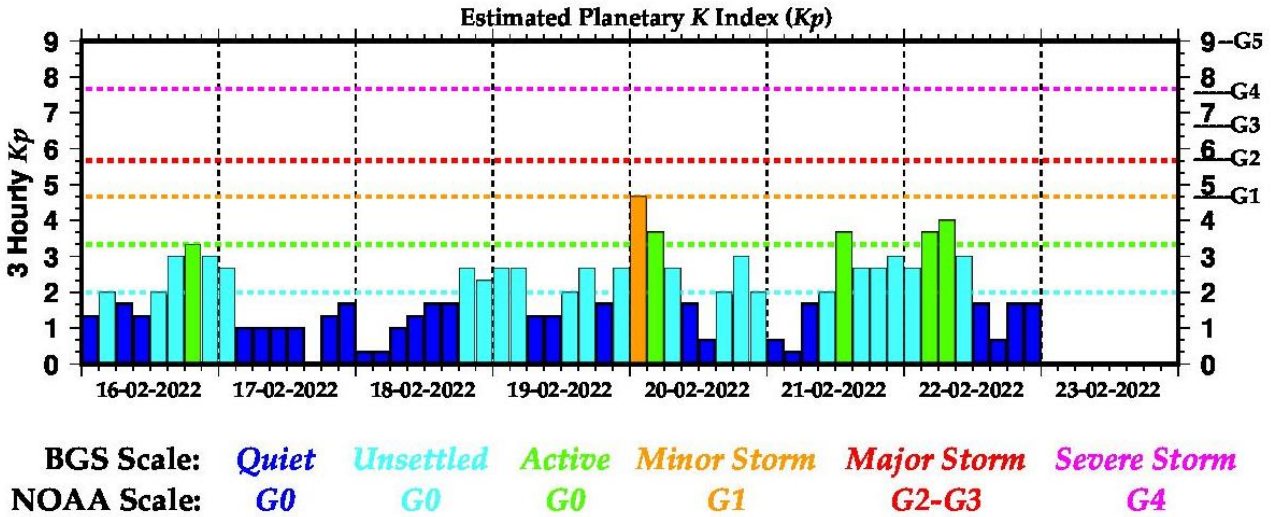
Geomagnetic Storms:

There are no Earth-directed CMEs in the forecast, although there is a slight chance of weak CME effects on days 1 or 2 (23rd/24th) from a glancing blow from a filament lift off that occurred on the 19th Feb (Low confidence).
Solar wind speeds are currently elevated, due to the high speed stream from CH56/+. They are expected to remain elevated during day 1 (23 Feb), before gradually declining towards ambient levels through the remainder of the period as the effects of the coronal hole wane. Geomagnetic activity is expected to start Quiet to Unsettled, with a chance of Active intervals and slight chance of a G1/Minor Storm. However, this risk will reduce through the forecast period and activity is expected to become predominantly Quiet from day 2 (24 Feb).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	2	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

Figure 2: BGS Estimated Planetary K index (Kp) - Quiet to Active on the 22nd.



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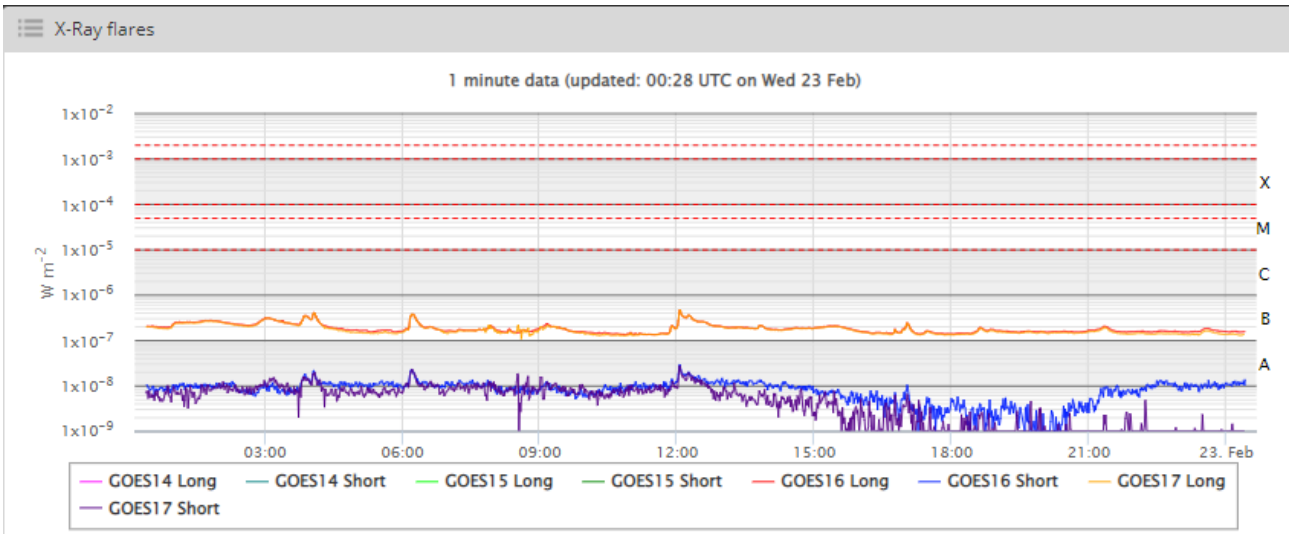
Radio Blackouts - X-Ray Flares:
There are currently three sunspot groups on the visible disc. AR2954 appears to be a mature but stable Hsx/Alpha region. AR2955 to the SE was the region that is thought to have been the source of an energetic flare and CME on the far side on the 15th. It has already produced a long duration C3.1 flare on the 21st but was quiet through the 22nd, this region is currently also classified as an Hsx/Alpha region. AR2953, classified as a Cri/Beta region has shown some growth in its intermediate spots and areal extent, but remains stable and inactive.
Solar activity has been Very Low over the past 24 hours with no significant flares. It is likely to remain Low through the forecast period but there is a slight chance of it increasing to Moderate, with M-class flares, as the two regions in the NE rotate further onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	20	20	20
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 3: GOES19 X-Ray flares. All quiet.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 has returned to background levels. Unless we see further significant flares it is likely to remain at background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

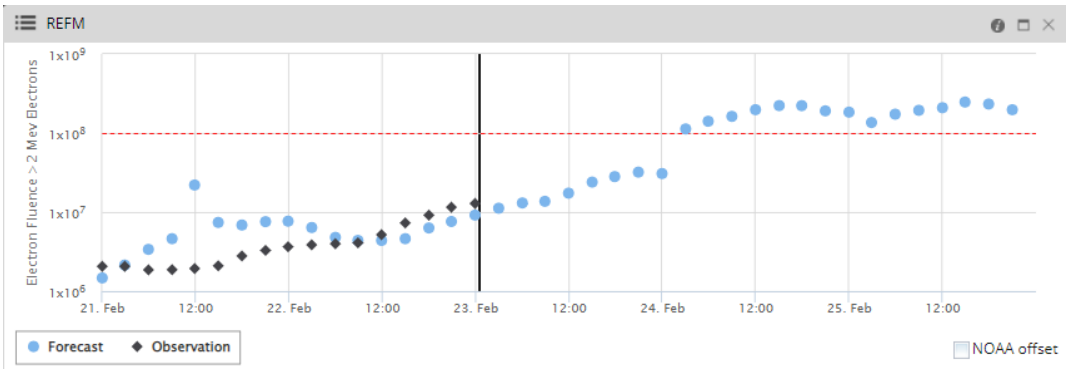
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO has increased from background levels to moderate levels. Electron flux is expected to rise in the coming days, perhaps peaking during the diurnal maximum at High levels (greater than 1000 pfu) on day 1 (23rd) and likely from day 2 (24th Feb) onward.

The associated 24 hour Fluence is currently well below the Active threshold and on a slight rising trend. There is a gradually increasing chance of Fluence levels becoming Active (>1e8 integrated pfu). REFM is showing an overall rising trend in electron fluence over the coming days and can be used as a rough guide for likely fluence values.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	30	40	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REF Model- Slowly rising trend forecast.



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